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PRINCIPLES OF OFFICE
DESIGN AND LAYOUT

By

[illegible]. C. BREHM

NAVY COMPTROLLERSHIP PROGRAM

1952 - 1953

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CHAPTER I

INTRODUCTION

A recent poll indicated the following desires of office workers in the order of their importance: money; good working conditions; security; a sense of satisfaction; prestige; variety of work; recognition; and opportunity for expression[1]. We note that "good working conditions" is placed second in importance. Good working conditions mean more than a happy office "esprit" — they also mean the physical surroundings in which a person must work. This subject has been gaining in importance through the years, and a wealth of material has been written on good office design and layout. This paper represents a codification of recent articles on the subject.

To illustrate the importance of good physical surroundings the following editorial is of intrest:

> In connection with its recent National Office Furniture Week, the Office Furniture Association emphasized the belief of its leaders that failure to hold office employees is due largely to an outmoded office surroundings. Along the same lines, A.C. Howard, president of Globe-Wernicke Co. told the recent annual meeting of the Office Equipment Manufacturers Institute that "good surroundings ensure good workers".[2]

This paper will enumerate principles which should be taken into account in designing an office. It will concentrate on the physical aspects of good layout and design, and no attempt will be made to show how a study of work or paper flow influences the proper placement of office equipment or space utilization.

Factors Involved in Office Design

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[1] Homer B. Harrison, What does a modern Office Cost?, Office Management and Equipment, August 1952, p. 24.

[2] Editorial, Office Management and Equipment, December 1952, p. 19

What are the factors involved in office design?. The fundamentals involved can be enumerated as follows:

1. Office Layout (involving planning and standards)
2. Lighting
3. Partitions
4. Air Conditioning or Ventilation
5. Under floor Ducts
6. Floor Coverings
7. Acoustical Treatment
8. Painting
9. Furniture and Equipment
10. Service Facilities
11. Decorations (involving color, venetial blinds, draperies, and other elements of a decorative character)[3]

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[3] L.O.M.A. Quarterly Review (issued to members of the Life Office Management Association), New York, N.Y., January 1, 1952

CHAPTER II

LIGHTING AND COLOR IN AN OFFICE

Color

Color and lighting go hand-in-hand. Correct color and lighting can often overcome many handicaps imposed by space, location, personnel and peculiar problems affecting an individual station or type of work which must be done.

Color, for example, lacks size, wight, shape or material

Color cannot be seen without the aid of light

Color is subject to changed appearance under different types and intensities of illumination.

Yet-- it can look warm or cold, bright or depressing, pleasing or irritating, stimulating or relaxing, clear or dingy. The color of walls , ceilings, floor coverings, desks, and other furniture can govern psychological moods. In addition to the psychological moods of people induced by color, other practical considerations influence choice of color; glaring white walls, for example, soil too readilly, and often offer no rest and relaxation to the eye as office workers look up from the white papers on their desks or in their typewriters. Dr. Matthew Luckiesh , an outstanding authority on light and lighting, has written the following on the use of color in the work-world:

> Studies and considerations of color throughout the strictly utilitarian, purely esthetic, and broadly psychological applications lead into many of the highways and byways of human reactions and activities.
> int Fortunately, consideration of color in the work-world is somewhat simplified. Its use is automatically restricted for the reason that good seeing conditions are of primary importance and they depend primarily upon brightness. Esthetic considerations properly must await the realization of the primary purpose of an interior in the work-world, which is to make seeing quick, easy, safe, accurate and comfortable. Furthermore, workers are work-beings, and what is satisfactory and appropriate for them is relatively restricted compared to the far great-

> er freedom in the use of color elsewhere. The work-world is a sober place of serious work. Indeed, the environment should be pleasant, cheerful, comfortable, and easy on the eyes and the workers. Also it should be appropriate. In fact, appropriateness is very improtant in the esthetic and psychological realms.[4]

Let us examine the possibilities of color in the office from the basic viewpoints of serious work being done by workers giving their major attention to work. A working area which presents a variety of colors is inappropriate, annoying, confusing and disturbing. Simplicity should be the cardinal principle in any color-scheme which is to be lived with for long periods. Certainly there is no sound or defensible reason for using strong color on ceilings, overhead structures and upper walls. This leaves the remainder of the walls, the supporting columns, if there are any, and the equipment to receive color if desired.

Among the colors available for offices, green, light greyed-green, or bluish green have sounder bases for acceptance than any others. Psychologically green is a fairly neutral color. It leans toward "coolness" if it is bluish green rather than yellowish green. These are the predominant colors in most landscapes. For this reason they are not novel, exotic, or rare. Light greyed-green is pale enough to be effective in reflecting light, and greyed enough to attract little notice and conceal soilage. Colors which are too strong in chrome (too pure) not only distract from work but are so noticeable that personnel will weary of them.

Color can provide subtle stimulation without distraction. It can make a small office appear larger. The combination in proper relationship and harmony of receeding colors (the cool colors which have gren in them), and colors which appear to advance toward the eye (the warm colors in the

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[4] Matthew Luckiesh, Light and Color in the Work-World, U.S. Gutta Percha Paint Company, Providence, R.I., 1945, p. 10

red and yellow color families) can alter the apparent distance of the wall from the desks.

The more stimulating colors can be used to give refreshing contrast in areas not used for actual working space.

In an office without sunlight, or whose windows front on a drab wall, a moderately warm color scheme for the walls may be appropriate. Sunny yellows, and light and medium buffs would be valuable. Even subdued peach or apricot may be visualized. Cool greens ease psychological discomforts where there is too much heat. An office with east, south, or west exposures, can utilize green color schemes which are cool and not too far from neutral.

An office with too-high ceiling can be made more liveable with a relatively darker color which "brings the ceiling down".

The Powers of Colors

Color and colors have certain complex influences which humans create through experience. These influences vary with an individual's experience. Therefore, in many respects a given color or combination of colors appeals differently to different individuals. One may like or dislike red for a personal reason. This is true of all other colors. Therefore, any specification of color for an environment to be occupied by others, and particularly by persons whose tastes, likes, dislikes, associations and experiences are not known, should be based upon generalizations of the influences of color which are known to be quite universal. Following are some powers of colors which are reasonably universal.

Beginning at the red end of the spectrum, the reds and adjacent orange-reds are relatively exciting. Apparently this influence is maximum for deep orange. The exciting influence continues through red-purple, crimson, scarlet, orange and yellow.

The cheerful influence is maximum for yellow. It extends in one direction as far as yellowish green at least, and in the other direction merges into the stimulating and exciting influences of orange and red.

A tranquilizing influence is universal for the greens. It extends in both directions in the spectrum. It gives way to the cheerful influence of yellow and it eventually is submerged by the other influences of blue and violet.

Passing from green through blue-green to blue, the colors become colder, more subduing and even depressing.

The purples extend from violet through purple and red-purple to red. They have no place in the office excepting for small markings if quite a number of distinctive colors are needed.[5]

The Effects of Color on Lighting

The various types of incandescent and fluorescent lighting vary greatly both in their own color and in their effect on apparent colors of painted surfaces. Compared to the yellowish-orange incandescent light which we are most familiar with, "Daylight" fluorescent looks bluish, the popular "3500° White" fluorescent looks slightly yellow-green, the "Soft White" fluorescent (the most flattering to foods and "complexions") looks slightly purplish, while the new 4500° white most closely approximates the color of natural daylight.[6]

The color chosen under one light, therefore, may prove disappointing or even unpleasant under another. The only safe procedure is to choose paint colors under the same type of light planned to be used with them.

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[5] Matthew Luckiesh, Color and Colors, (D. Van Nostrand Co., New York, N.Y., 1938)

[6] Color for Industry, U.S. Gutta Percha Paint Company, Providence, R.I.

Table I lists a series of colors and shows light sources which are desirable for each. It also shows light reflectivity of each color.

Darker colors tend to absorb light. The more reflection offered, the better result in terms of foot candles of lighting intensity from the same light fixtures and electric current consumption. However, if walls reflect too much light they will dazzle the eye and do more harm than good.

The desirable light reflection for office areas is greatest light overhead, medium light in the middle, and darkest underfoot. Generally, 80% light reflectivity for ceiling colors, 50% for upper walls, and 35% for the lower wall areas subject to scuffing, is considered a good rule-of-thumb.

TABLE I

EFFECTS OF LIGHTING ON THE DECORATION COLORS[7]

	Fluorescent						Light
	Daylight	4500 Whith	White	Soft White	Warm Tint	Incandescent	Reflective Efficiency
Maroon	dull	dull	dull	dull	fair	good	30%
Red	Fair	dull	dull	fair	good	good	15
Pink	fair	fair	fair	fair	good	good	70
Rust	dull	fair	fair	fair	good	good	40
Orange	dull	dull	fair	fair	fair	good	50
Brown	dull	fair	good	good	fair	good	15
Tan	dull	fair	good	good	fair	good	60
Golden) Yellow)	dull	fair	fair	fair	good	good	60
Yellow	dull	fair	good	good	dull	fair	75
Olive	good	fair	fair	fair	brown	brown	10
Chartreuse	good	good	good	good	yellowed	yellowed	70
Dk. Green	good	good	good	fair	dull	dull	20
Lt. Green	good	good	good	fair	dull	dull	75
Peacock) Blue)	good	good	dull	dull	dull	dull	8
Turquoise	good	fair	dull	dull	dull	dull	40
Royal Blue	good	fair	dull	dull	dull	dull	40
Lt. Blue	good	fair	dull	dull	dull	dull	55
Purple	good	fair	dull	dull	good	dull	10
Lavender	good	good	dull	dull	good	dull	60
Magneta	good	good	fair	dull	good	dull	40
Grey	good	good	fair	soft	soft	dull	55

NOTE: These are approximate figures subject to variations in color used.

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[7] Howard Kethum, Put your Office to Work, Office Equipment and Management, August 1952, p. 31

Lighting

What is good lighting? Good lighting is controlled lighting which aims toward the following objectives:

1. Even illumination which can be approached through planned lighting fixture layout.

2. Low surface brightness, wherein glare is reduced to a minimum by fixture design.

3. Reduction to the minimum of brightness contrasts between surrounding and background surfaces.

Proper lighting in an office is an absolute necessity. Matthew luckiesh has listed the advantages accruing from good lighting:

1. The performance rate of useful work rises
2. Fewer errors are made
3. Less time and fewer materials are wasted
4. Eye fatigue, mental fatigue, and general fatigue are reduced
5. Employees are kept at a higher peak of efficiency for a greater part of the day
6. The accident hazard in areas like staircases, corridors and storerooms is reduced.
7. There is a stimulating effect on morale[8]

It is significant to realize that one-cuarter of our body energy is used for the act of seeing alone. Yet too much light is more fatiguing than the use of too little light. For example, a Hohns Hopkins University study found that three hours of continuous reading under daylight reduces visual efficiency of the human eye by 92%, while direct incandescent light

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[8] Homer B. Harrison, What is involved in Office Design, Office Management and Equipment, October 1952, p. 87

of proper intensity, placed will out of the line of vision, causes 15% loss.[9]

Where close concentration is required over lengthy periods, a 50 to 60 food candle level is preferable, with over-all lighting raised accordingly to hold down the brightness contrast ratio. "Brightness", as the word is used by the Illuminating Society, does not mean the amount of light in a room, which is measured in foot-candles. Brightness is used as a comparative term to indicate the amount of light given off by any surface. The Illuminating Engineering Society recommends that no task object by more than 10 times brighter than any other adjacent to it.[10] Brightness contrast ratio is the basis on which color and lighting coordination are planned. The goal is to provide a light level about 3 times as great on the work surface as in adjacent areas. Too much dependence on the desk lamp and too little over-all lighting provide a 50 to 1 brightness ratio-- which is far too high. While only a lighting expert can chart office lighting scientifically, Table II contains general recommendations as a check list to examine the functional adequacy of lighting .

TABLE II

RECOMMENDED ILLUMINATION FOR WORK AREAS[11]

Typical Areas	Foot candles
Private Offices with available daylight	40
General Office open areas	50
File Department areas	60
Private offices with no available daylight	60-70
Office machine and detail working areas	70

Types of lighting fixtures

Luminous indirect fluorescent lighting equipment is fast becomming standard in offices. This type is found most comfortable to live with.

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[9] Howard Ketcham, Put Your Office to Work, Office Management and Equipment, August 1952, p. 33

[10] Brightness Controlled, Desk Glare Gone, Office Management and Equipment, November 1951, p. 76

[11] Kenneth H Ripnen, Lighting Plays Dynamic Part in Raising Office Efficiency Level, Office Management and Equipment, July 1951, p.25

with white ceilings a type of government designed equipment delivers 90% of its output to the white painted ceiling which then becomes a broad area of indirect illumination (70% reflectance). The 10% of the light which comes downward through the luminous plastic reflectors causes them to blend into the ceiling. Illuminating engineers call that "low brightness", meaning that the luminous plastic reflectors are close to the brightness of the ceiling behind it that the reflector does not stand out or glare.[12]

This basic lighting unit (No. 355 in the government design is four feet long, and contains two 40-watt, T-12 fluorescent tubes to the unit. These units can be fused singly or joined in continuous rows. In a paper given before the Illuminating Engineering Society in 1951, Mr. Thomas F. Goghlan, elèctrical engineer with the Public Buildings Service of the General Services Administration, referred to an interesting and unusual characteristic which appears to be inherent in this type of lighting. He stated:

> As dust accumulates on the lighting equipment and on the ceiling, their comparative brightness ratios tend to draw closer together and improve, even though the quantity of the light is naturally reduced by the depreciation of the lamps and the accumulation of the dirt.[13]

Summary

Good lighting factors can be summed-up as follows:

1. The brightness-ratio between the fixtures of a general lighting system and their background should be as small as possible.

2. The brightness-ratio between the visual task and its immediate surroundings should be as low as possible. For example, this printed page can be read with greater ease and accuracy when its immediate surroundings

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[12] Martin Deac, "Twenty-Five Miles of Office Lighting, Office Management and Equipment, March 1952, p. 32.

[13] Ibid, p 33.

such as a desk-top, are of approximately the same brightness as the page.

3. The brightness of the specific task should be as great as any major areas in the entire visual field. Usually this cannot be achieved without supplying supplementary light to the task from glareless local light-sources in addition to the light supplied by the general lighting system. The supplementary lighting also provides a means of fitting light to the tasks.

4. In many cases in the office details must be seen silhoutted against a background whose brightness is controllable. If each worker's tasks are studied, whether they are performed at a machine or a desk, the proper treatment of the background is generally quite obvious.

The Esthetic Effect of Lighting

There is a limit to how much factual engineering can do to solve the office lighting problem. It may meet the physical needs in foot-candles and lumen measurements. It will meet the problem of eye comfort, improve the visual acuity, and therefore the output of the worker. But what will it do for the steno or typist in terms of her own ego? To her the question "How do I look" hits at the basis of her emotional well-being, and consequently, affects her morale, efficiency, and her output as a worker. The answer must be sought in the realm of the Arts rather than that of the sciences. This approach would delete the esthetic error made in so many offices where rows upon rows of fluorescent lighting fixtures cast a highly unflattering light on women workers.

Several suggestions to alleviate this situation are proposed by Mr. Abe H. Feder, a prominent lighting designer with headquarters in New York.[14]

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[14] Abe H. Feder, Office Lighting--The Imaginative Approach, Office Management Review, April 1952, p. 227

He states that perhaps business offices would come closer to attaining emotional as well as visual comfort for their workers if those who plan them would think of new lighting developments as new tools rather than as complete answers. The fluorescent lights could be spread out instead of being run in rows, and mounted behind a ceiling made of a translucent material instead of housed in individual fixtures. The result would be a glowing luminous ceiling rather than harsh tracks of lights. Also, other kinds of added incandescent floodlights recessed at strategic points could be added to blend with and add sparkle to the flat fluorescent lighting. The result would be an office in which people would not only see well but look well.

CHAPTER III

ACOUSTICAL TREATMENT

Noise interferes with efficiency, slackens and dulls mental processes, lessens precision, exacts a toll on the nerves, induces absenteeism, contributes to turnover, in general can be classed with poor ventilation and bad lighting.

The Aetna Life Insurance Company, Hartford Conn. did a comprehensive study on this problem. Before they moved into a new building, they made a careful and complete study of the effect of noise on employees to determine the extent of projected sound conditioning that should go into the new structure. The test was made on the control department, where 30% of the employees were on a bonus plan . The department also included typists, checkers, machine operators and other employees. It was found that the efficiency of bonus workers increased 9.2% in the first year they worked in the sound conditioned room. The result of a test period of 2 years showed that the typists errors decreased 29% and those of machine operators 52%. The Bell Telephone Laboratories also estimated that noise which decreased the efficiency of a routine worker will decrease the output of an executive by 30%.[15]

Needless noise should be eliminated; there are certain inescapable sounds characteristic of the operation of most offices, such as the clatter of typewriters and the noise of other machines. Most office sounds can be confined to their source by properly installed sound conditioning which can reduce the overall noise level as much as 40% to 60% with a potential 10% increase in the efficiency of employees. Office noise

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[15] Melvin E. Krampf, Noise Costs Money, Office Management and Equipment, July 1952, p. 77

itself generally is not annoying. It is the reflection of noise that causes most of the trouble. Noise waves strike hard surfaces, such as walls and ceilings, then bounce back where they meet other oncoming waves. Unless steps are taken, the waves override each other and the result is confusion.

The average office records about 60 decibles -- a sound-conditioned one about 50. This does not sound like a great reduction, but the picture changes when it is considered that 50 decibles have a physical intensity of 100,000 energy units, while 60 decibles have 1,000,000 or 10 times as many. At the threshold of painful sound, 120 decibles, the physical intensity is several billion units.

As a general rule, sound conditioning is satisfactory if the ceiling is covered with one of the materials which have been developed and tested by members of the Acoustical Materials Association. If ceilings are high, it may be necessary to sound condition part of the walls.

Acoustical products are made of a variety of materials. Experimental use of these different materials has shown that no one of them will do all jobs equally well. For a particular installation one's choice should be one that will meet the acoustical requirements of the room. Other considerations should also be taken into account. These are; moisture resistance where high humidity conditions exist, light reflection, decorative possibilities, structural strength, and maintenance costs.

Acoustical materials absorb sound waves and change sound energy to heat energy. A good acoustical material will absorb 70% of sound and reflect only 30%.

If the noise problem is concerned chiefly with high pitched sound, the materialshould have high absorption at the higher frequencies. This is a technical subject and should be left to a trained acoustical engineer. Most members of the Acoustical Materials Association furnish this ad

this advice gratis. The engineer will first study the present office noises, recommend a suitable tile of the proper frequency, select where it should be placed and how it should be erected.

Table III is a table of coefficients for the various materials that constitute typical interiors. This list is useful in making simple calculations of reverberation. The higher the coefficient, the greater the sound absorption will be.

TABLE III

COEFFICIENTS OF GENERAL BUILDING MATERIALS[16]

Material	Coefficients		
	128cps*	512cps*	2048cps*
Brick wall, painted	.012	.017	.023
Brick wall, unpainted	.024	.03	.049
Carpet, unlined	.09	.20	.27
Carpet, felt lined	.11	.37	.27
Fabric hung straight			
Light, 10 oz per sq. yd.	.04	.11	.30
Medium, 14 oz per sq. yd.	.06	.13	.40
Heavy, draped, 18 oz per sq. yd.	.10	.50	.82
Floors, wood	.05	.03	.03
Floors, concrete	.01	.015	.02
Glass	.035	.027	.02
Marble or glazed tile	.01	.01	.015
Plaster, smooth finish	.013	.025	.04
Plaster, smooth finish on lath	.02	.03	.04
Plaster, rough finish on lath	.039	.06	.054
Wood Panelling	.08	.06	.06

* Cycles per second. The number of cycles doubles with each higher octave in the musical scale.

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[16] Melvin E Krampf, Noise Costs Money, Office Management and Equipment, July 1952, p 77

CHAPTER IV

PARTITIONS

More often than onot an office must be placed in an area that is either devoid of partitions or so completely partitioned off as to make the place seem like a succession of cubby holes.

Movable partitions seem to offer many advantages. Not only do they make maximum use of what space there is available, but their easy installation or removal are most attractive in a naval installation which is continually expanding, consolidating or changing in mission.

In addition, it takes a few days at most to install movable partitions in the fashion that best suits the current flow of office work. Better still, office routing can go on, since there is no debris, no excessive noise, dust removal, and no dirt. The partitions can be used over and over, an economy factor that makes the original cost (roughly equivalent to the cost of conventional walls) of less significance as time goes on. These walls are fireproof, yet only 1/4 to 1/8 the weight of conventional walls-- a strong advantage where floor loading is a prime consideration.

There is on the market a type of panel construction-- a non-mettallic composition board of absolute permanent flatness which is almost identical to steel panels. The three inch movable wall is more soundproof than a tile and plaster wall of twice that thickness. It has four times the insulating qualities of a clay tile wall plastered on both sides. These units can be wired for air conditioning, phone, and other electrical connections by means of "lay-in" raceways in both base and cornice as well as panel connections.[17]

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[17] Alvin M. Haltel, Trends in Movable Office Partitions, The Management Review, September 1951, P. 532

It should be remembered that the erection of too many private offices is bad from the light, ventilation, and space viewpoint. The biggest single contribution to office flexibility is the elimination of as many partitions as possible.

Many companies manufacture movable panels. Although they vary in height and general construction, their functions are the same.

CHAPTER V

OTHER FACTORS

Under-floor Ducts

Because the arteries which carry the wiring are buried in the floor and cannot be seen, they too often are not given the importance they demand. In an old building there is not much that can be done about them. In new new buildings the grid pattern for under-floor ducts can be so planned that only the installation of a high or low tension insert is necessary to bring wiring to any possible desk or equipment location.

Service Facilities

In planning the office, cinsideration should be given to every possible service facility, such as wash rooms, cafeterias, parking facilities, and the availability of public transportation

Air Conditioning

Jess Larson had this to say about air conditioning in government offices:

> Consider air conditioning. Electronic and other types of filters will make the air we breathein buildings better and cleaner than we can find anywhere. --------- air conditioning has made the "block type" building possible, just as steel and the elevator made the skyscraper possible. I doubt if we ever build a wing-type building again. Floor space simply costs too much in a wing-type plan.[18]

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[19] Jess Larson, Air Conditioning in Government Buildings , Office Management and Equipment, December 1952, p. 65

CHAPTER VI

OFFICE LAYOUT

Introduction

What is layout planning? Very seldom has the arrangement of work places been planned. Many of them just developed or grew that way. If Navy office space was planned, the original functions of the office have long since disappeared, or the functions have been increased or decreased to such an extent that there is no semblance of planning layout. Desks and files are squeezed in from time to time, and so the whole thing (like Topsy) just grew.

Layout Planning Analysis

A detailed analysis is required to achieve the most efficient relationship of work places. This analysis is composed of 3 simple steps, and they can be applied to any type of layout planning. These steps are:

1. Put the problem on paper
2. Show lines of flow
3. Convert flow lines to machine (or desk) lines[20]

The first step is to put the office on paper. It is easier to see the inefficiency of the improper relationship of work areas on paper than it is in the office. Particular attention should be given to the location of columns, doors, windows, aisles, radiators, and utilitiės.

The next step is to determine the functions performed, the methods used, the person performing each task, and finally the relationship of one job to another. Out of this analysis should come a clear picture of the work performed, and a pattern of the flow of paper through the office.

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[20] John R. Immer, *Layout Planning Techniques*, McGraw-Hill Book Company, 1950, p14.

The functions performed should be listed first. This will provide a logical basis for later subdivisions and will enable the planner to break the task into units which he can analyze more easily. The number of people involved in an individual function or department and the nature of their activities will determine the quantity of desks and equipment and the total space requirements.

Although the space required per individual may vayy, the general practice is to allow 100 square feet per person in making preliminary estimates of space requirements. The average of 100 square feet per person for office workers provides for office corrodors. Elimination of office corridors cuts the average to 80 square feet per person. Space requirements vary due to the variety of work performed. Other general yardsticks are:

For each major executive	400 sq. ft.
For each sub-executive	200 sq. ft.
For each central active file dept. - per file	5 sq. ft.
For each inactive file dept. - per file	3½ sq. ft.[21]

Using these standards, space requirements for an office section can be computed. Figures for sections can be then combined to show total space needed for the office. Figures obtained on this basis will most likely result in a larger amount of space that is available. In this case percentage cuts may be made or more detailed studies instigated to see where space may be reduced.

After the layout planner has gathered information on paper flow and general space requirements, he must take into consideration various limiting factors, because an office layout cannot always be based solely upon functional and utilitarian requirements. Personalities, the peculiar physical

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[21] Kenneth H Ripner, Space Standards in the Office Layout, Office Equipment Digest, November 1952, p. 23

shape of the office, overriding considerations peculiar to the functions of the office are some of the many factors which the layout planner must ascertain before he proceeds very far with his analysis and planning. Others can be enumerated as follows:

1. Area requirements of departments, private offices, coat rooms, stock rooms, rest rooms. These allotments in many instances depend upon whether secretaries share offices with executives, and an inventory of furniture needed in the office operation.

2. Safety factors. These include the number and location of exits, and the freedom of passage to exits

3. Lighting and ventilation

4. Isolation of noisy departments

5. Physical requirements of railings and partition runs

6. Location of telephones, buzzers, intercoms, desk lights, convenience outlets, clocks, and other services

The flow of work through an office should be shown graphically as well as by locational charts and guides. The ideal is to make the flow of work through the office as short as possible. The office should have a good functional plan or work flow arrangement. This saves countless hours of lost time in going from there to here. The same number of people can produce more work or it may take fewer people to do the same amount of work. It establishes direct routes or traffic for mail, messengers, and employees with a minimum amount of disturbance and confusion to all workers.

With this ideal in mind, and consistent with the limiting factors, the equipment can be arranged in the provided space. Templets provide an effective tool in making up the final layout. They consist of patterns of the various pieces of equipment cut to scale from cardboard or other stiff material. Their use makes it easy to experiment with various

layouts until a satisfactory layout is found. Templets are inexpensive tools and provide the most satisfactory method of evolving the best solution to the average layout problems[22].

After all changes have been made and the layout in final form is approved, complete instructions for the move and the changes to theoffice to be made should be published. The instructions should provide a move schedule, which lists each item of equipment, where it is to be moved, and its old and new location. The move should be accomplished to provide as little disruption of office routine as possible.

Space Utilization

Jess Larson, Federal General Services Administrator, speaking on the topis "No Space for Waste" at the "Office of the Year Awards Luncheon" on October 20, 1952, stated:

> As a general rule, we insist that all users of government sapce must
> 1. Utilize open space, eliminating partitions wherever possible
> 2. Double-up in private offices, eliminating as many single occurancy rooms as possible
> 3. Study agency space layouts leading to better program efficiency in less space
> 4. Consider the transfer of records not needed for day-to-day use to a records depository
> 5. Eliminate all unnecessary furniture from active office areas[23]

Standards

Standards in office layout are invaluable because:

1. They facilitate planning future requirements
2. They aid in making efficient office layouts
3. They prevent costly and acrimonious disputes, as all people in a category receive identical equipment and facilities
4. They prevent the purchase of luxury items on the one hand, and inadequate or inferior items on the other
5. Furniture can be readilly moved from office to office[24]

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[22] John R. Immer, Layout Planning Techniques, McGraw-Hill Book

A committee sponsored by the National Office Management Association under the procedure of the American Standards association has provided a range of over-all dimensions of metal and wood desks and tables commonly used in the modern business office. The larger executive desks-- over 60 inches in width-- are mot covered. This will be a great aid to office managers in reducing the number and variety of equipment used and simplifying ordering and reordering of equipment. It will promote a more flexible furniture arraingement in an office, encouraging and facilitating interchange of personnel and equipment. Table IV lists the standards usedl

TABLE IV
STANDARDS FOR OFFICE DESKS AND TABLES [25]

General Classification	Overall Top Dimension (In inches) Metal Width	Metal Depth	Wood Width	Wood Depth
Double Pedestal	50	30	50	32
	55	30	52	32
	60	30	58	32
	60	34	60	34
Single Pedestal	40	30	42	32
	45	30	44	32
	45*	34*		
Tables	45	30	42	32
	50	30	44	32
	55	30	50	32
	60	30	52	32
	60	34	58	32
			60	34

*Flat top or fixed bed typewriter desks only
Single pedestal disks have drawer or compartment arraingement at only one side of the user's position
Double pedestal desks have drawer or compartment arraingements at both sides of the user's position
Width is the long dimension measured from edge to edge of the desk or table top.
Depth is the short dimension measured from front to back edges of the desk or table top

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[23] Space Control pays off in Federal Offices, Office Management and Equipment, December 1952, p. 62

[24] C. I. Keelan, Establishing Standards for Office Space and Office Furniture, Office Management and Equipment, July 1951, p. 30

[25] First Two Standards Set for Office Equipment Field , Office Management and Equipment, August 1951, p. 29

Arrangement Factors for Office Layout

The following arrangement factors have been suggested by the Policyholders' Service Bureau as a guide to the layout of a department after the location of the individual departments of an office have been determined[26].

1. Aisles or passageways, leading to the main exits should never be less than 44 inches wide, preferably 66 inches wide. Minimum aisle space between rows of desks: 36 inches for a secondary aisle, 44 inches for intermediates, and 60 inches for a main aisle.

2. The working space between the back of one desk and the front of the next desk-- the clerical seat space-- should never be less than 28 inches, preferably 36 inches. The preference for the latter spacing occurs where there are more than 2 desks in a row.

3. If files are set up front-to-front or if it opens toward an aisle, desk or other piece of equipment, the main and subsidiary aisles should equal 44 to 66 inches and 28 to 36 inches respectively when the file drawers are open.

4. If shelving is set up front-to-front or if it opens toward an aisle, desk or other piece of equipment, the main and subsidiary aisles are equal to the depth of the shelving plus 44 to 66 inches for main aisles and 28 to 36 inches for subsidiary aisles.

5. Large open spaces are better than the same space cut into smaller rooms, because they make control and communications easier and provide better light.

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[26] John R. Immer, Layout Planning Techniques, McGraw-Hill Book Co., 1950, p. 365, as reproduced by permission of the policy holders service bureau, Metropolitan Life Insurance Company.

6. Solid wall partitions should be avoided because of their inflexibility. Metal, composition, or other movable partitions are preferable.

7. When partitions are installed around clerical groups, two adequate means of exit should be provided.

8. Persons using pens or pencils should have the light coming over the lift shoulder. Those using typewriters may have the light coming over either shoulder. No employee should face the light.

9. Desks should face in the same direction. They should not face each other unless two people work together. Desks should not be placed tightly against, and facing a wall or partition.

10. For maximum efficiency, not more than two desks should be set side by side, enabling each person to be on a aisle and get in and out without disturbing anyone else. The highest practical number of desks per row is five.

11. Desks should be arranged to give a straight line flow of work so that each desk occupant will receive his work from the person behind or beside him.

12. Files should be placed against walls or railings if possible.

13. Heavy safes should be located close to walls or columns to prevent as much strain as possible on the beams.

14. If lockers are to be placed inside a department, they should be located near the exits but not close enough to block passage or to interfere with the work of those sitting hear them

15. Employees should be placed near the person having authority over them.

16. Those who do the "closest" work should be located nearest the light.

17. Employees having the most communication with other sections should be located nearest the exits.

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